ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 2000
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602709A Night Vision Technology / PROJECT: DH95

COST (*In Thousands*)	FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
DH95 Night Vision and Electro-Optic Technology	18341	20021	20465	20574	20341	21503	22887	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program element (PE) develops core night vision and electronic sensor technologies for Army weapons systems. Advanced next generation focal plane arrays (FPA), mega-pixel infrared (IR) and multispectral (cooled and uncooled) are being developed that will see farther, provide advanced signal processing, and improve performance on the dirty battlefield. In collaboration with industry, uncooled IR sensor technology is being developed to reduce cost and weight and increase reliability/performance. Advanced driver electronics are being developed to reduce power consumption and improve the contrast and brightness of miniature flat panel displays for future aviation, infantry, armored vehicle, and field maintenance applications. Micro-laser sources will provide affordable, high performance technology options for the individual soldier, tactical laser rangefinding, designating, obstacle avoidance, and laser radar. Distributed micro-sensor (thermal, acoustic, magnetic, etc) networks will provide a revolutionary increase in battlespace awareness that will improve soldier survivability, lethality, situation awareness, and enable commanders and staffs to plan, decide, and execute operations with greater speed and tempo. Aided/automatic target recognition (ATR) technologies will enable dramatic reductions in the time to acquire targets, detect land mines, and collect intelligence data while also reducing the warfighter's cognitive workload. Performance and utility of ATR will be quantified in the ATR Evaluation Center of Excellence. Hardware-in-the-loop multispectral sensor simulations are being developed that will allow end-to-end predictive modeling and evaluation of new technologies in a virtual environment while allowing warfighters to test these capabilities, develop tactics and techniques, and train in parallel with the hardware development process. Imaging sensors are being developed for the Anti-Personnel Landmine Alternative program. This program element supports Land Warrior and Army After 2010 future systems. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Tri Service Reliance Agreements on Sensors and Electronic Devices. Work in this program element is related to and fully coordinated with PE 0602712A (Countermine Technology), and PE 0603710A (Night Vision Advanced Technology). This program is managed primarily by the Communications-Electronics Research, Development and Engineering Center (CERDEC), Night Vision Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

FY 1999 Accomplishments:

- 4710
  - Developed architecture for partitioning smart integrated circuit processing hardware functions between on- and off-focal plane to improve sensor performance and reduce processing hardware requirements for weapons platforms.
  - Designed analog-to-digital conversion and fusion processing architectures for a monolithic infrared focal plane array (FPA) read-out integrated circuit (ROIC).
  - Evaluated data throughput, heat dissipation, and circuit fabrication requirements for varying on-focal plane read-out circuit configurations with a goal of increasing read-out capacity by an order of magnitude.
  - Developed and evaluated fabrication processes for monolithic infrared focal plane arrays in experimental semiconductor microfactory and transitioned successful processes to industry consortia members.
  - Developed large staring focal plane array technology in support of SMDC's overhead sensor technology for battlefield awareness program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 2000
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602709A Night Vision Technology
PROJECT: DH95	

FY 1999 Accomplishments: (Continued)

		– Demonstrated a fully registered (i.e. pixel elements for each color view exactly the same area) dual color camera, midwave infrared/longwave infrared (MWIR/LWIR), 320x240, 2 mil pixel .
		– Fabricated and tested a 1024x1024 MWIR mercury cadmium telluride (MCT) array.
		– Grew material for and processed a two color (near infrared (NIR) and SWIR/MWIR) focal plane array.
•	1489	– Completed common source laser brassboard and demonstrated multiple functions in different wavelength bands.
		– Evaluated diode pumped laser source technology and investigated new high peak power laser diode structures for a micro eyesafe laser to reduce the size, weight, and power consumption of manportable laser devices.
•	3494	– Conducted ATR evaluations of multispectral and large format staring infrared sensors in increasingly complex dynamic operational scenarios.
		– Evaluated sythetic aperture radar (SAR) ATR capability to include metrics to quantify improvements in situational awareness.
		– Developed MWIR staring sensor ATR evaluation capability.
		– Developed adaptable computing hardware to enable real-time ATR processing of multi-sensor data.
•	3694	– Demonstrated a real-time MWIR and LWIR synthetic scene rendering capability in sensor prototyping and wargame simulations.
		– Expanded predictive modeling capability to accurately predict sampled imagers.
		– Completed comparison between real and synthetic forward looking infrared (FLIR) imagery for ATR evaluation applications.
		– Demonstrated infrared simulation capability and utility in support of the Anti-Personnel Landmine Alternative (APLA) program.
•	3960	– Developed and tested an uncooled focal plane array device for a low cost solid state near infrared 320x240 camera with potential of day and night operation with sensitivity comparable to present image intensifier tube technology, and improved capability to detect camouflaged targets.
		– Debuted and demonstrated the world's smallest microsensor uncooled infrared camera weighing less than 180 grams, about the size of a D cell battery.
		– Demonstrated an uncooled sensor with an unprecedented sensitivity of approximately 8mK for a 2 mil pixel and 47 mK for a 1 mil pixel.
•	400	– Baselined sensor packaging and configuration for UAV and space application and conducted initial demonstration of on-FPA processing of spectral data.
•	594	– Designed and developed a prototype micro eyesafe solid state laser.
Total	18341	

FY 2000 Planned Program:

•	3900	– Design and develop a 1024x1024 LWIR FPA for application to overhead sensor technology for battlefield awareness.
		– Integrate analog to digital conversion circuitry on an infrared FPA to reduce read-out circuit noise and improve detector response to target or background temperature differences.
		– In collaboration with industry, demonstrate an advanced ROIC with non-uniformity correction circuitry on an infrared focal plane array that will calibrate all detector pixels to provide a uniform response to target or background temperature differences.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 2000
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602709A Night Vision Technology / PROJECT: DH95

- 912 – Develop prototype fabrication processes for growing next generation, multi-spectral infrared detector arrays directly on a silicon semiconductor read-out circuit.

FY 2000 Planned Program: (Continued)

- 4600 – Design instant-on capability for uncooled IR micro camera.
  – Collect target and background signature data with dual color and near infrared cameras to support comprehensive characterization of reflectivity differences of typical "un-modified" targets, camouflaged targets, cultural background objects, and natural background materials.
- 3700 – Develop advanced physics based performance, and search/target acquisition models needed to support next Generation FLIR engineering trade studies and operational utility assessments.
  – Develop a multispectral simulation environment to support design trade-offs, development, and evaluation of multi-function staring sensor suite and mine hunter /killer advanced technology demonstrator programs.
  – Validate infrared sensor simulation.
  – Integrate realistic sensor simulation interactive capability into Battle Lab Warfighting Experiments.
- 1250 – Demonstrate ATR processing architecture for space/volume constrained applications and platforms using adaptable computing technology.
  – Develop partitioning and software translation tools to allow system/hardware specific ATR software to be ported to different processing architectures.
  – Establish the utility of synthetic and hybrid imagery to evaluate and quantify the performance of hyperspectral and multi-sensor mine detection ATRs.
- 1400 – Integrate IR/charge coupled device (CCD) micro-sensors with acoustic and seismic micro-sensor to provide vastly increased threat distinguishing effectiveness of the micro-sensor node.
  – Develop a comprehensive uncooled IR FPA model for defining theoretical performance limits.
  – Develop fixed network of IR micro-sensor arrays to enhance target detection capabilities, define communication links, and training requirements.
- 2000 – Develop low power 640x512 flat panel displays and associated drive electronics for dismounted soldier applications.
- 1000 – Develop a 1 lb. micro-laser that is low cost and provides 2Km range performance.
- 240 – Complete testing of the Cooperative Eyesafe Laser Project (CELRAP) (Partner: Japan).
- 700 – Develop a hyperspectral sensor with smart focal plane processing in the 1-2.5, 3-5, and 8-12 micron wavebands, and improve cueing and clutter rejection via polarization and on-FPA processing using ground test. Analyze and incorporate appropriate warfighter hyperspectral technologies.
- 319 – Funds reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Authorization Act of 1992.

Total 20021

FY 2001 Planned Program:

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 2000
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602709A Night Vision Technology / PROJECT: DH95

- 4125 – Develop a prototype process for fabricating on focal plane micro-lens that will focus incident radiation on small pixel detectors and provide improvements in detector sensitivity and sensor performance.
  – Develop and test prototype advanced lithography process that will reduce the number of fabrication steps for infrared focal plane arrays.
- 700 – Demonstrate on-chip neomorphic processing, hyperspectral spatial and temporal signature processing with sensor using airborne testing.

FY 2001 Planned Program: (continued)

- 1535 – Investigate and develop prototype process for semiconductor microfactory fabrication of optical readout circuitry that will be required to simultaneously readout the response from high speed, large area (640x480 and 1024x1024) dual color FPAs. Limited capacity readout circuits are a major technical barrier to higher performing next generation infrared devices.
  – Design next generation MWIR and LWIR FPA devices that provide high performance at elevated operating temperatures (120K vs current 77K).
- 4550 – Complete testing and evaluation of near infrared solid state cameras based on alternative detector materials, characterize performance, and define manufacturing yield issues for the alternative materials.
  – Define design parameters for a low cost, uncooled near infrared and far infrared sensor for dismounted soldier applications that provides a fused output of the two spectral bands to enhance the operator's perception of "color" contrast, shadows, and depth.
- 3370 – Extend physics based performance and search /target acquisition constructive modeling to support additional sensor domains including, countermine and multispectral sensors.
  – Validate multispectral models and simulations for target acquisition, driving, and pilotage applications; incorporate upgrades into interactive Battle Lab simulation environment in order to support new sensor concept evaluations and weapon systems trade studies and optimization.
- 1255 – Demonstrate an open "heterogeneous" ATR processor architecture that is capable of hosting ATR software/algorithms designed for unique or propriety hardware, thereby reducing the time and cost required to integrate ATR capability into new platforms.
  – Extend ATR evaluation capability to smart focal plane sensor systems.
- 1490 – Demonstrate small scale integrated network of acoustic, seismic, and imaging micro-sensors that will provide a significant unattended tactical sensing capability to detect, track, and classify time critical mobile and stationary targets.
  – Demonstrate low power consumption micro-sensors and support electronics that will permit unattended micro-sensor operation for up to 60 days.
  – Perform experiments utilizing prototype micro-sensor nodes in various configurations to optimize warfighter effectiveness.
- 2100 – Develop full color 640 x 512 flat panel displays to allow dismounted soldiers to utilize color maps and symbology to enhance the soldier's performance.
  – Develop color 800 x 600 flat panel displays for mounted version and aviation platforms.
- 240 – Perform final demonstration of the Cooperative Eyesafe Laser Project (CELRAP) (Partner: Japan)
- 1100 – Complete development and evaluate micro laser for performance, cost, and weight, for rangefinding and other requirements for the soldier.

Total 20465

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602709A Night Vision Technology

PROJECT: DH95

B. Program Change Summary	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 2000/2001 PB)	19008	20111	20966
Appropriated Value	19157	20111	
Adjustments to Appropriated Value			
a. Congressional General Reductions	-149		
b. SBIR / STTR	-361		
c. Omnibus or Other Above Threshold Reductions		-49	
d. Below Threshold Reprogramming	-230		
e. Rescissions	-76	-41	
Adjustments to Budget Years Since (FY 2000/2001 PB)			-501
Current Budget Submit (FY 2001 PB)	18341	20021	20465